Decision Rationale

**Total Maximum Daily Loads for
the Aquatic Life Use Impairments on Cedar Creek,
Hall/Byers Creek, and Hutton Creek**

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the TMDLs for the aquatic life use (benthic) impairments on Cedar Creek, Hall/Byers Creek, and Hutton Creek. EPA's rationale is based on the determination that the TMDLs meet the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDLs are designed to implement applicable water quality standards.
2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3) The TMDLs consider the impacts of background pollutant contributions.
4) The TMDLs consider critical environmental conditions.
5) The TMDLs consider seasonal environmental variations.
6) The TMDLs include a margin of safety.
7) There is reasonable assurance that the TMDLs can be met.
8) The TMDLs have been subject to public participation.

II. Background

The Cedar, Hall/Byers, and Hutton Creek watersheds are located in Washington County, Virginia. They are all tributaries of the Middle Fork Holston River which is located within the Tennessee Big Sandy River basin. The watersheds are relatively small, each is less than 10,000 acres. The impaired segments for each of the streams originates at its headwaters and terminates upon its confluence with the Middle Fork Holston. Cedar Creek has a 4,629-acre watershed and is 9.98 miles in length. Hall/Byers Creek has a watershed area of 9,991-acres and is 11.72 miles in length. Hutton Creek has a 7,149-acre watershed and is 10.89 miles in length. Agricultural lands make up the majority of the lands within each watershed. Seventy-nine percent of the Cedar Creek watershed is

composed of agricultural lands, the remainder of the watershed is split between urban (13%) and forested (8%) lands. Sixty-six percent of the Hall/Byers watershed is composed of agricultural lands with the remaining lands divided between urban (13%) and forested (20%) lands. The Hutton Creek watershed is also dominated by agricultural (66%) lands with the remainder of the watershed composed of urban (10%) and forested (23%) lands.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed Cedar, Hall/Byers, and Hutton Creek (VAS-O05R) on Virginia's 1998 Section 303(d) list as being unable to attain the general standard for the aquatic life use and the bacteriological criteria for the primary contact use. The bacteriological (fecal coliform) impairments were addressed by TMDLs developed in 2001. Virginia has developed implementation plans for the fecal coliform TMDLs and is in the process of implementing these plans. This decision rationale will address the TMDLs for the impairment of the general standard for the aquatic life use. The failure to attain this use was determined through biological assessments of the benthic macroinvertebrate community.

Virginia's 305(b)/303(d) guidance states that support of the aquatic life beneficial use is determined by the assessment of conventional pollutants (dissolved oxygen, pH, and temperature); toxic pollutants in the water column, fish tissue, and sediments; and biological evaluation of benthic community data.[1] Therefore, a biological assessment of the benthic community can be used to determine a stream's compliance with the state's general standard for the aquatic life use. Virginia uses EPA's Rapid Bioassessment Protocol II (RBPII) to determine status of a stream's benthic macroinvertebrate community.[2] This approach evaluates the benthic macroinvertebrate community between a monitoring site and its reference station. Measurements of the benthic community, called metrics, are used to identify differences between monitored and reference stations.[3] Please note that the state is currently in the process of changing this methodology to a stream condition index (SCI) approach.

As part of the RBPII approach, reference stations are established on streams which are minimally impacted by humans and have a healthy benthic community. These reference stations represent the desired community for the monitored sites. Monitored sites are evaluated as non-impaired, slightly impaired, moderately impaired, or severely impaired based on a comparison of the biological community of the reference and monitored sites. Streams that are classified as moderately (after a confirmatory assessment) or severely impaired after an RBPII evaluation are classified as

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[1]VADEQ. 1997. 1998 Water Quality Assessment Guidance for 305(b) Water Quality Report and 303(d) TMDL Priority List Report. Richmond, VA.

[2]Tetra Tech 2002. Total Maximum Daily Load (TMDL) Development for Blacks Run and Cooks Creek. Fairfax, Virginia.

[3]Ibid 2

impaired and are placed on the Section 303(d) list of impaired waters. During the 1998 assessment period, Cedar, Hall/Byers, and Hutton Creek (Three Creeks) were identified as being moderately impaired. Water quality appears to have improved on these streams probably as a result of the restoration/remediation efforts occurring within the watersheds associated with the previous TMDL. When evaluating these streams under the SCI approach their scores indicate a minimal impairment exists.

The RBPII assesses the health of the macroinvertebrate community of a stream. The analysis will inform the biologist if the stream's benthic community is impaired. However, it will not inform the biologist as to what is causing the degradation of the benthic community. Additional analysis is required to determine the pollutants which are causing the impairment. TMDL development requires the identification of impairment causes and the establishment of numeric endpoints that will allow for the attainment of designated uses and water quality criteria.[4] A reference watershed approach was used to determine the stressors and the endpoints for the Three Creeks TMDLs. Numeric endpoints represent the water quality goals that are to be achieved through the implementation of the TMDLs which will allow the Three Creeks to attain their designated uses. A reference watershed approach is based on selecting a non-impaired watershed that shares similar land use, ecoregion, and geomorphological characteristics with the impaired watershed. The stream conditions and loadings in the reference stream are assumed to be the conditions needed for the impaired stream to attain standards.

To determine whether a stream was a suitable reference site for the monitored sites, the modelers evaluated the topography, soils, ecoregion, land uses, watershed size, and point source inventory of the potential reference site. All reference site candidates were evaluated as nonimpaired in the biomonitoring analysis. The reference site selected for the Three Creeks TMDL was Walker Creek. Walker Creek was evaluated as unimpaired when using both the RBP II or SCI approach.

The next step in the TMDL development process was to determine the loadings and stressors in the monitored and reference watersheds. Low dissolved oxygen (DO), sedimentation, habitat modification, nutrients, and toxic pollutants were evaluated as possible stressors to the monitored streams. Ambient water quality monitoring (AWQM) on the streams documented temperature, DO, pH, turbidity, total suspended solids (TSS), nitrogen, and phosphorous. To get a better understanding of the DO concentrations during the most critical periods, an early morning sampling was conducted on August 29, 2003. Samples were collected from each of Three Creeks between 5:30 and 6:00 a.m. These samples were taken at the end of the summer season when the lowest DO concentrations are expected to be found due to a combination of high water temperatures (lower solubility of oxygen) and low flows. They were also collected prior to dawn when photosynthesis commences and DO levels increase. All of the samples collected during this period had DO concentrations in compliance with the applicable criteria.

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[4]Ibid 2

Toxicity testing was also conducted for water samples collected from the Three Creeks. The testing compared the survival and reproduction rates or fathead minnows (Pimephales promelas) and water fleas (Ceriodaphnia dubia) in water collected from the impaired sites with an unimpaired water source. The test did not document any statistically significant effects associated with fathead minnows or water fleas reared in water from the Three Creeks. After this analysis, toxicity was not viewed as an issue on the monitored sites.

In general, the Three Creeks had poorer water quality than Walker Creek, please see Section 3.0 of the report for additional information on these results. Therefore, several stressors were seen as possible causes or contributors to the benthic impairment on the Three Creeks. However, after reviewing the benthic and water quality data it was determined that excessive sediment was the most possible stressor. Therefore, the TMDLs were developed to control sediment, the controls needed to address this problem will limit the amounts of nutrients to the Three Creeks as well. It should be noted again that based on the SCI results the biological community on these streams is being minimally impacted as a result of the best management practices (BMPs) that have already been put in place as a result of previous TMDL efforts.

The next step in developing these TMDLs was to determine the sediment (the stressor) loadings to the monitored and reference segments. The Generalized Watershed Loading Functions (GWLF) model was selected as the means to determine loadings to the streams. The GWLF model provides the ability to simulate runoff, sediment, and nutrient loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land).[5] GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.[6] Calculations are made for sediment based on daily water balance totals that are summed to give monthly values. To equate the reference watershed with the monitored watersheds, the reference watershed was decreased in size to that of the impaired watersheds in the model, the land uses were proportionally decreased based on the percent land use distribution. Therefore, the land use breakdown in the reference watershed remained constant.

Local rainfall and temperature data were needed to simulate the hydrology. The Wytheville (precipitation) and Bristol (temperature) weather stations were used for these TMDLs. To insure that the models accurately predicted the stream flow the modeled flow results were compared to the observed flows, a process known as calibration. The models' parameters were adjusted based on these results to insure the most accurate representation of the system. The Three Creeks were modeled to the flow on a United States Geological Survey (USGS) gage in the Middle Fork Holston River. Walker Creek was modeled to a USGS gage within its watershed. Walker Creek was modeled from April of 1980 through March of 2000. The model was driven by data collected at the

[5]Ibid 2

[6]Ibid 2

two weather stations over the same period of time. The Three Creeks were modeled to flow data collected from April of 1988 through March of 1989. The results of the models are documented in Section 5.0 of the report. Table 1 documents the TMDL allocations to the Three Creeks.

Table 1 - Summarizes the Sediment Allocations for the Three Creeks TMDLs.

Segment	TMDL (lbs/yr)	WLA (lbs/yr)	LA (lbs/yr)	MOS (lbs/yr)*
Cedar Creek	3,071,470	1,789	2,762,560	307,121
Hall/Byers Creek	5,526,021	57,533	4,916,733	551,755
Hutton Creek	4,306,282	91	3,875,474	430,717

* Virginia includes an explicit MOS by reserving the 10 percent of total loading to the MOS.

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing aquatic life use (benthic) impairment TMDLs for the Three Creeks. EPA is therefore approving these TMDLs. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDLs are designed to meet the applicable water quality standards.

The Three Creeks were listed as impaired due to a degradation of their benthic macroinvertebrate communities. As mentioned above, benthic assessments inform the biologist of an impairment, but they are unable to identify a stressor. Therefore, a reference watershed approach was used to identify the stressors to these streams. Virginia has indicated that excessive levels of sediment have caused the degradation of the benthic communities in the Three Creeks. The Commonwealth does not have numeric standards for sediment at this time. Therefore, the loading obtained from the reference watershed was used as the endpoint for these TMDLs. Its believed that if the streams can reduce their sediment loadings to that of the area weighted reference watershed, the impairment to the benthic communities will be relieved.

The GWLF model was used to determine the loading rates of sediment to the stream from all point and nonpoint sources. The TMDL modelers determined the sediment loading rates within each watershed. Data used in the model was obtained on a wide array of items, including land uses in the area, point sources in the watershed, weather, stream geometry, etc..

The GWLF model provides the ability to simulate runoff and sediment loadings from

watersheds given variable source areas (e.g., agricultural, forested, and developed land). GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.[7] To equate the reference watershed with the monitored watersheds, the reference watershed was decreased in size to that of the impaired stream in the model. Each land-use was decreased in equal proportion, insuring that the land use breakdown in the reference watershed remained constant. Local rainfall and temperature data were needed to simulate the hydrology, this data was obtained from the Wytheville and Bristol weather stations. In the GWLF model, the nonpoint source load calculation is affected by terrain conditions, such as the amount of agricultural land, land slope, soil erodibility, and farming practices used in the area.[8] Parameters within the model account for these conditions and practices. Since there were flow gages within the impaired and reference watersheds, the hydrology component of the model was calibrated to observed flow data.

EPA believes that using GWLF to model and allocate the sediment loadings to the Three Creeks will ensure the attainment of the designated uses and water quality standards on these streams. Several BMPs have already been put in place within the watershed in association with the Implementation Plan for the Fecal Coliform TMDL. These BMPs which are geared to remove cattle from the stream have alleviated some of the sedimentation problems within the streams as observed via the recent benthic assessments. The Three Creeks TMDLs did not account for the BMPs and therefore a portion of the reductions called for in the TMDLs are in all likelihood already be in place.

2) The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of nutrients and sediment to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 1 of this document. The total allowable load is calculated on an annual basis.

Waste Load Allocations

Virginia has stated that there are four regulated point sources discharging to the Three Creeks. Three of the four facilities are small, discharging less than twenty thousands gallons of effluent per day (gpd). One of the facilities, Emory Meadowview Waste Water Treatment Plant (WWTP), is permitted to discharge 630,000 gpd. The WLAs can be determined by multiplying the permitted flow by the

[7]Ibid 2

[8]Ibid 2

permitted pollutant concentration. The WLAs are the maximum allowable amount of sediment which may be discharged in all likelihood the actual discharge should be lower. Since facilities often discharge at lower rates and concentrations than what is provided in the permit.

EPA regulations require that an approvable TMDL include individual waste load allocations (WLAs) for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table 2a - TSS WLAs for the Three Creek

Stream	Facility	Permit Number	Permitted Flow (gpd)	Permitted Concentration (mg/L)	TSS Load
Cedar Creek	Meadowview Elementary School	VA0030589	16,000	30 mg/L	1,461
Cedar Creek	Dillow's Shop and Wash	VA0071366	4,000	30 mg/L	328
Hall/Byers Creek	Emory-Meadowview WWTP	VA0087378	630,000	30 mg/L	57,533
Hutton Creek	SFH STP	VAG400181	1,000	30 mg/L	91

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), load allocations (LAs) are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the GWLF model to represent the impaired watersheds. The GWLF model is a comprehensive modeling system for the simulation of watershed hydrology, point and nonpoint source loadings, and receiving water quality. GWLF uses precipitation data for continuous and storm event simulation to determine total loading to the impaired segments from the various land uses within the watershed. Many BMPs have been implemented in the Three Creeks watershed as a result of the Implementation Plan for the Fecal Coliform TMDLs. The BMPs were not written into the GWLF model. The sediment loadings to the Three Creeks represents pre BMP conditions. Table 3 provides the LA for all

of the nonpoint sources.

Table 3 - LA for Sediment for Three Creeks

	Cedar Creek		Hall/Byers Creek		Hutton Creek	
Land Use	LA Sediment (lbs/yr)	Percent Reduction	LA Sediment (lbs/yr)	Percent Reduction	LA Sediment (lbs/yr)	Percent Reduction
Cropland	1,750,145	38.2	2,487,659	34	1,805,246	26
Pasture/Hay	999,621	36.2	2,427,982	33.8	2,069,314	25
Transitional	12,172	0.5	0.0	0.0	0.0	0.0
Forest	19.6	0.0	91.4	0.0	75.6	0.0
Urban	602.6	0.5	1,000.4	0.02	839.2	0.5
Total	2,762,560		4,916,733		3,875,474	

3) The TMDLs consider the impacts of background pollution.

The reference watershed approach inherently considers the impact of background pollutants by considering the sediment load from all land uses, including forested lands, within the impaired and reference watersheds. The TMDL is developed to attain the loading seen in the reference watershed which has a load from natural sources.

4) The TMDLs consider critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the Three Creeks is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be

undertaken to meet water quality standards[9]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition when the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The GWLF model was run over a multi-year period for the reference watershed to insure that it accounted for wide range of climatic conditions within the reference watershed. The allocations developed in the TMDL will therefore insure that the criteria is attained over a wide range of environmental conditions.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Pollutant loadings also change during the year as vegetation grows making it more difficult for sediments to runoff. Consistent with the discussion regarding critical conditions, the GWLF model and TMDL analysis effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and modifying the soil loss equations based on the time of the year.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia includes an explicit MOS by allocating 10 percent of the total TMDL loading to the MOS.

7) There is a reasonable assurance that the TMDLs can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and

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[9]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

The TMDL in its current form is designed to meet the applicable water quality standards. The Commonwealth intends to implement this TMDL through best management practices (BMPs). The implementation of these practices will occur in stages. This will allow the Commonwealth to monitor the benefits of the BMPs and determine which practices have the greatest impacts on water quality. It will also provide a mechanism for developing public support and checking the accuracy of the model. The success exhibited in the implementation of the fecal coliform TMDL and the improvement seen in the benthic community as a result of this effort, demonstrates the communities willingness to improve water quality through the implementation of BMPs.

8) The TMDLs have been subject to public participation.

The first public meeting was held on January 27, 2003 at Patrick Henry High School in Glade Spring, Virginia. The second meeting was held at the same location on September 23, 2003. Information was added to the TMDL regarding the adoption of BMPs in the watershed as a result of comments received during the second meeting.